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METHODS OF RELIEVING THE WATER SHORTAGE IN BALTIMORE[1]

The water supply conditions in Baltimore are complicated by a shortage of water for the population within the old city limits and by the necessity of establishing a policy for the water supply of a large suburban district, now served by nine private companies, which was recently annexed to the city.

More water must be provided for the old city territory as quickly as practicable. In 1918 and 1919, the average daily consumption was about 110,000,000 gallons. The maximum consumption for a single day sometimes reached 154,000,000 gallons, and the average daily consumption during the month of greatest demand was 121,000,000 gallons. The months of greatest demand usually occur in seasons of drought, when the available supply is very low. Under the present operating conditions, as will be explained later, there is practically no available storage in the Loch Raven reservoir, where the Gunpowder River is impounded to furnish a supply, and the average flow of this river during a dry month has fallen to 54,000,000 gallons a day. In an emergency the city can obtain water from Jones Falls, but in very dry weather not much more than 6,000,000 gallons a day will probably be available from this source.

The capacity of the eight reservoirs within the city is 1,200,000,000 gallons. During periods of drought, when Gunpowder River and Jones Falls may furnish only 60,000,000 gallons a day, the result of a continued average daily consumption of 110,000,000 gallons will be to exhaust the stored supply in 24 days, leaving the city with but half the daily supply it now requires. This will happen when the demand is usually greater than the average for the year.

Some relief can be obtained by reducing the waste of water in the city. The consumption is now about 180 gallons per capita daily. It is highly desirable to start a water waste survey at once and metering should be carried on as rapidly as possible to prevent the outlay of unnecessary sums for enlargements of the water system which will benefit nobody. In this way, perhaps as much as 20,000,000 gallons of water now wasted daily can be saved.

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[1] Review by the Editor of a report to William F. Broening, Mayor of Baltimore, by Nicholas S. Hill, Jr., Consulting Engineer, New York, and James H. Fuertes, Consulting Engineer, New York.

To meet the present situation, there are four possible developments of additional supplies. The water for the old city is impounded at Loch Raven dam, which has its spillway at El. 188. Tipping gates[2] have been placed on the spillway which raise the water level to El. 192, but these gates open when the water rises above that elevation so that the permanent effective high water level at Loch Raven is El. 188. The catchment area above the dam is 308 square miles.

The water flows from Loch Raven to a pumping station at Montebello through a tunnel 12 feet in diameter and 7 miles long. This tunnel is not lined throughout and there is some question whether it will be possible to increase the head on the tunnel by any substantial amount without causing serious leakage from the tunnel, unless the portions now unlined are lined.

At Montebello the water is lifted from the tunnel by pumps to a filtration plant, from which it flows by gravity to the low-service district of the city. In the city there are three pumping stations supplying intermediate and high-service distribution systems.

The center line of the Montebello pumps is at El. 199.25, and as it is unsafe to count on a suction lift of more than 21 feet, the lowest safe water level in the tunnel at the pumping station, under the existing conditions, is 199.25–21 or El. 178.25. The present maximum operating head is, therefore, 188–178.25 or 9.75 feet. Actual measurements show that when water is flowing through the tunnel at the rate of 154,000,000 gallons daily, the friction head is 9.75 feet. It will be seen that the maximum safe capacity of the tunnel under present operating conditions does not exceed the present maximum daily consumption.

There is another serious aspect of the present conditions. There is not sufficient water stored for distribution in the small reservoirs in and near the city to equalize the fluctuations in the demand on the filtration plant. The latter must be operated at varying rates in order to meet these fluctuations. In time of maximum demand, in order to obtain the necessary quantity of water, the full head of

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[2] See JOURNAL, June, 1919, page 297.

9.75 feet on the tunnel is necessary, and this can only be obtained by keeping the water at Loch Raven dam at the elevation of the spillway and giving up all attempts to consider the storage at Loch Raven, under existing conditions, as available for use at any time. The additional storage created by the tipping dam may be available, but it is not certain.

In order to obtain an ample supply for present needs and the demands of the near future in the old city of Baltimore, water can be obtained by further developing the Gunpowder watershed or by utilizing the Patapsco River watershed. These developments must be accompanied by an increase in the capacity of the filtration plant, the construction of new distributing reservoirs and a new high-service pumping station, and improvements in the system of distribution mains. There are four of these projects which have enough merit to be considered in detail.

In developing the Gunpowder River supply, it is necessary to increase the quantity of water stored and to provide means for bringing more water to the Montebello filters than the existing tunnel will deliver under the present operating conditions.

There are two methods of obtaining more storage on the Gunpowder River. One is to raise the Loch Raven dam and the other is to construct one or more additional reservoirs on the watershed. The dam was designed and its foundations constructed so that the spillway can be placed at El. 240. If any attempt is made to place the spillway higher than that the cost of the work will be greatly increased by the necessity of relocating a considerable mileage of railroad and by damages due to flooding a portion of the village of Cockeysville. Additional storage can also be obtained by building a dam on the Gunpowder River about 3 miles from Parkton, called the Prettyboy dam. If its spillway is placed at El. 520, about 24,000,000,000 gallons will be impounded, which can be allowed to flow down the river to the Loch Raven reservoir as needed there.

There are two methods of bringing more water from Loch Raven to the Montebello filters; one is to build a new tunnel and the other is to utilize the old tunnel to better advantage than is practicable under existing conditions.

The better utilization of the present tunnel is made possible by the existence near the filtration plant of Lake Montebello which, when full, has its water level at El. 163, 15.25 feet lower than the minimum permissible elevation of water in the tunnel at the present pumping station at Montebello. This water may be discharged from the tunnel into the lake, and by building a new low-lift pumping station at the lake, the water can be delivered from it to the filtration plant. The lake will thus serve as an equalizing basin, materially reducing the present fluctuations in the velocity through the old tunnel and enabling the average discharge to approach more nearly to the full capacity of the tunnel than is now safe. With the spillway at Loch Raven at El. 240, there will be about 22,000,000,000 gallons storage at that place, and this water can be delivered to Lake Montebello under an effective head of 23 feet, if desired. Under this head the old tunnel will deliver 240,000,000 gallons daily, and by regulating the gates at Loch Raven this quantity can be reduced as desired.

The Patapsco River can be utilized by taking advantage of the present development of that stream by the Baltimore County Water & Electric Company at Avalon. The catchment area above this point is 321 square miles. An intake, pumping station and filtration plant must be built there, from which water can be pumped into the city's low-service distribution system or into both the low and intermediate systems. The flow of the river at Avalon during the driest months is probably about 54,000,000 gallons daily, and if a plant is built for this development it will be desirable for it to have a capacity of 50,000,000 gallons daily.

In addition to increasing the quantity of water available for the old city of Baltimore it is necessary to enlarge the capacity of the Montebello filters if the increased supply comes from the Gunpowder watershed, construct a distributing reservoir near the southwestern boundary of the city to equalize the effect of the large fluctuations in the hourly consumption in the low-service district on the filtration plant whether it be solely at Montebello or partly there and partly at Avalon, to modify the distribution system so that the storage in the existing distributing reservoirs will also help in steadying the load on the filters, and to construct two new high-service distributing reservoirs with a pumping station and improvements in the mains. If such equalizing storage is provided, the additional filtration capacity required is not over 52,000,000 gallons daily. If the storage is not provided the additional filters should have a capacity of at least 100,000,000 gallons daily. The four most desirable projects for improving the supply of the old city include the equalizing storage facilities just mentioned.

Project 1. Raise Loch Raven dam to El. 240, build a new 12-foot tunnel 7 miles long from Loch Raven to Montebello, construct the Prettyboy reservoir, abandon the Montebello pumps and operate the filters by gravity, add filtration capacity of 52,000,000 gallons daily and construct equalizing storage works on the distribution system. The total first cost is estimated at $20,853,000, giving an annual cost of $1,065,300 and making the annual cost per million gallons of capacity $18.53. This is the most expensive project and will take the most time to construct. The watershed above the Prettyboy reservoir is not large enough to prevent protracted low stages of the water in that basin, with heavy growths of vegetation on the exposed bottom. This project is not recommended.

Project 2. Raise Loch Raven dam to El. 240, build a new 12-foot tunnel 7 miles long from Loch Raven to Montebello, enlarge the present Montebello pumping station, pump from the tunnel to the filters when the water in Loch Raven reservoir is below El. 230.5 and deliver it by gravity at other times, add 52,000,000 gallons to the daily filtration capacity, and construct equalizing works on the distribution system. This project calls for a capital outlay of $17,457,000 and the annual charge will be $912,400. The annual cost per million gallons of capacity will be $17.66. This project will take longer to construct and cost more than Project 3 and is not recommended.

Project 3. Raise Loch Raven dam to El. 240, deliver water through the present tunnel to Lake Montebello, abandon the present pumping station there and erect a new 185,000,000-gallon station to pump from the lake to the filtration plant, add 52,000,000 gallons daily to the filtration capacity, and construct equalizing storage works on the distribution system. The capital outlay for this project is $13,994,000 and the annual charge will be $899,150. The annual cost per million gallons of capacity will be $17.41. This is the cheapest in first cost of the plans for obtaining water from the Gunpowder River and can be carried out most quickly.

Project 4. Take water from the Patapsco River at Avalon, construct a 50,000,000 gallon filtration plant and high-lift pumping station there, and construct equalizing storage works on the distribution system. The first cost will be $9,642,000 and the annual cost $775,150. The annual cost per million gallons of capacity will be $19.70. This is the cheapest in first cost and the annual cost per million gallons of capacity is reasonable, but as the availble supply from this source is insufficient to meet present needs it cannot be considered alone.

The immediate undertaking of Project 3 is recommended, but the adoption of Project 4 is also advised in order to secure enough water for the next twenty years. The Patapsco supply may be quickly developed at reasonable cost, it will be delivered to the city in a way which will help equalize pressures in a large part of

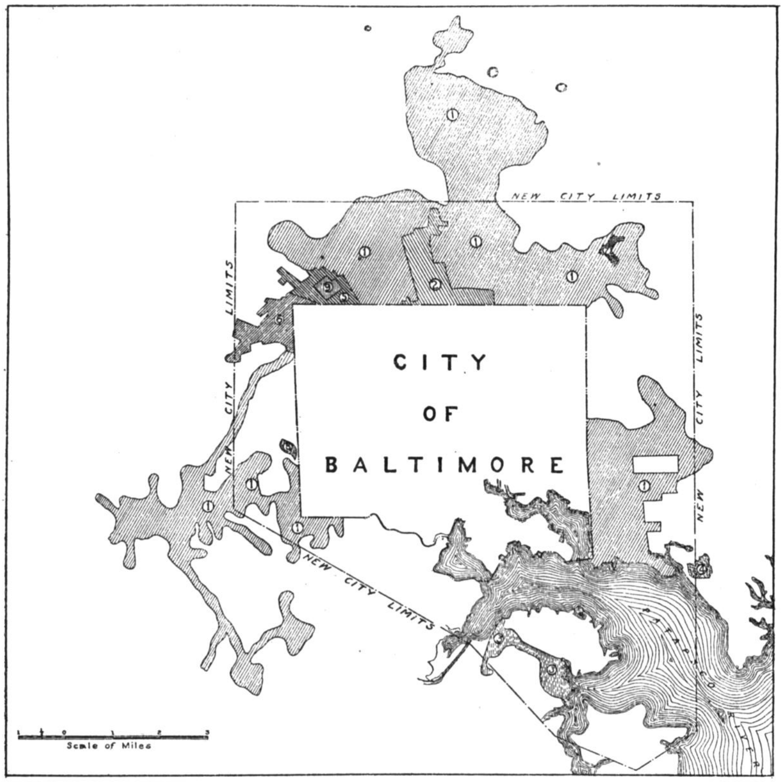

Fig. 1. Limits of the Old City of Baltimore, of the Annexed Territory, and of the Areas Served by Private Water Companies.

1. Baltimore County Water & Electric Company's Territory. 2. Roland Park Water Company's Territory. 3. Brooklyn & Curtis Bay Light & Water Company's Territory. 4. Dundalk Water Company's Territory. 5. Suburban Water Company's Territory. 6. Artesian Water Company's Territory. 7. Evergreen Lawn Water Company's Territory. 8. Rognel Heights Water Company's Territory. 9. Denmore Park Hotel, Water, Light & Heating Company's Territory.

the city, and will cost no more than the development of 50,000,000 gallons from the Gunpowder basin in addition to the quantity provided under Project 3.

What has been said up to this point applies only to the old city of Baltimore. The water supply of the recently annexed districts presents troublesome technical, financial and administrative problems. There are nine private companies which are furnishing about 7,000,000 gallons daily to from 70,000 to 75,000 persons in this Annex, as the territory is called. The Baltimore County Water & Electric Company is the largest of these and supplies about 5,600,000 gallons daily; it also furnishes water to a large number of consumers outside the city. It is the only company which was not primarily part of a real estate development. There is no possibility of increasing the output of the eight small companies except for temporary local use. One of them supplies only 150 houses in the city and another supplies a small area outside the city. Before the city can extend its water mains into any territory occupied by the nine private companies, shown in figure 1, it must acquire by purchase or condemnation their property in the territory the city proposes to enter.

On January 1, 1920, the valuation of these properties, based on the cost of reproduction, was estimated at $3,900,000 by the engineers and $5,543,000 by the companies. The annual cost of operating the pumping stations and maintaining the sources of supply of the companies is estimated at $100,000 to $125,000.

The total capitalization of the Baltimore County Water & Electric Company is $1,283,000; the valuation of its property based on the cost of reproduction is estimated at $2,723,000 by the engineers and $3,819,000 by the company. The supply is obtained from the Patapsco River at Avalon, west of the city, and from Herring Run to the east of the city, and the company owns water rights on the Little Gunpowder River near Bradshaw. The Herring Run supply is of inferior quality and small quantity, and the company has been advised to abandon it and to supply the district now served with Herring Run water from a new plant to be built on the Little Gunpowder, which has a catchment area of 57.5 square miles above Bradshaw.

If the city acquires the plants of the private companies a heavy expenditure will be needed for their rehabilitation and a large sum must be spent for connecting the city mains to those of the companies. All told, if the city takes over the plants, it will probably have to spend about $5,500,000 for the works, franchises, rehabilitation, connections and operation until water can be furnished from the new city supply. In addition it must either furnish water during the period of reconstruction to the old consumers in the Annex at the present rates, which have been approved by the Maryland Public Service Commission, or else reduce the rates to those now charged in the old city of Baltimore, which do not equal the cost of furnishing the water, the deficit being met by a contribution from the general taxes.

It is apparent that the acquisition of the private plants will be expensive, that with the same rates now charged in the old city they will not yield a sufficient return to pay for the investment in them, and that the only valuable additional supply secured with them is the Patapsco River. Therefore there is no strictly economic justification for their purchase. There are other reasons, however, which render the purchase advisable.

Some of these private supplies are of poor quality, and an outbreak of typhoid fever or other intestinal disease due to the infection of one of them may result in the spread of the disease by contact among the consumers of other water supplies.

As an administrative policy, it will be undesirable to allow private companies to operate within the city for a long period without an adjustment of rates so that all consumers within the city will pay the same rates. The Maryland Public Service Commission and not the city establishes the rates of private companies. These are fixed so that the companies may earn a fair return upon a fair valuation of their property. These rates are necessarily higher than those of the city. Unless the city can make an arrangement with the private companies whereby they will charge the same rates as the city and the city will undertake to make up the deficiency in their earnings as a result of this reduction, those residents of Baltimore supplied by the private companies must not only pay much higher water rates but must also, through their general taxes, help pay the cost of furnishing water to the consumers supplied by the municipal water works. One-seventh of the population of the city will not be content to suffer such discrimination long.

There are other reasons for acquiring these private water works. If the companies remain in existence there will be trouble between them and the city over extensions into territory now without water mains. The probability that the city will acquire the properties at some time will check their development by the companies, and as the service deteriorates there will be an increasing number of complaints which will inevitably lead to the purchase of the properties by the city

Under all the circumstances, it is advisable to acquire these plants and apply to the legislature for authority to supply water in the immediate suburbs of the city. All future extensions of mains in this suburban district will then be under the direction of the municipal water department, in accordance with its plans and specifications. When the city boundaries are pushed backward again, as they have already been pushed back on two occasions, it will not be necessary to spend large sums for buying and rehabilitating water works unsuited for the future needs of the city.

The total capital outlay recommended for new supplies, purchase of private water plants, and the improvement of existing works is $21,785,000.